PATENT SPECIFICATION 1,160,439

DRAWINGS ATTACHED.

1,160,439

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COMPLETE SPECIFICATION.

Improvements to Soot Blowing Devices.

I, JEAN EUGENE JULIEN DULAIT, a Belgian subject, of 30, avenue Brugmann, St. Gilles-Brussels, Belgium, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a device for blowing out the soot to clean the inner faces of apparatus such as heat exchangers and boilers, comprising a mobile lance unit to be used to penetrate the said apparatus for the cleaning operations, said lance unit being provided with at least one blowing nozzle mounted on a rail-guided trolley for movement therewith.

The known soot blowing devices comprise a mobile lance provided at its end with one or a plurality of nozzles, through which escapes a blowing fluid, such as compressed air, or steam, for impinging on the internal faces of apparatus, such as heat exchangers and boilers, in order to clear them of the soot deposits accumulated thereon. The said lance is integral with a trolley, which, to enable the lance to be driven in or withdrawn from said apparatus, runs, hauled for example on a chain by means of a motor and a reduction gear, on a guide rail, the ends of which are connected to the frame-work of the building housing the apparatus. The disadvantage of this type of device is its large overall dimension. Indeed, in addition to the space needed for housing the drives and accessories of the lance, the full length thereof must, when in the rest position, be located outside the said apparatus. When a large size apparatus is used, the overall dimension of the device becomes excessive and, particularly when a plurality of apparatus are mounted side by side, the cost of construction of the buildings for housing said apparatus and the blowing devices together with the accessories thereof, becomes prohibitive.

The purpose of the invention is to overcome this disadvantage by providing a blowing device, the lance whereof is of low overall dimension when it is in the rest position.

For that purpose, according to the invention, the said mobile lance unit comprises two telescopically assembled components, the inner one named hereinafter the "lance" carrying said nozzle, means for rotating the external one, named hereinafter the "lance-carrier", driving means between the lance-carrier and the lance to rotate the lance as a result of the rotation of the lance-carrier and a screw inside the lance in engagement with a tapping on the inside wall of the lance to move the lance longitudinally relative to said lance-carrier and said trolley as a result of the rotation of the lance-carrier and of the lance.

A soot blower for boilers has been proposed in Patent Specification No. 1,029,668, having a trolley comprising a blowing fluid feeding cylinder inside which a rotatable lance passes through a control sleeve having an external thread in engagement with the thread of a sleeve rigidly secured to the cylinder. The lance is hollow and a triangular opening is provided in the wall thereof. The control sleeve is rotated with the lance and slides simultaneously along the lance because of the threaded engagement with the rigidly secured sleeve so as to uncover gradually the opening and admit the blowing fluid inside the lance. It should be noted that the telescopic arrangement between the control sleeve and the lance according to the said Specification No. 1,029,668 differs from the construction of

[*Price 4s. 6d.*]

the present invention in that in the latter the threaded engagement between the lance and the internal screw, and the driving rotating connection between the lance and the lance-carrier, provide a telescopical movement of the lance with reference to the lance-carrier, such lance-carrier not being provided in the construction of said Specification No. 1,029,668.

Preferably the driving means to rotate the lances as a result of the rotation of the lance-carrier comprise lugs provided on the lance and slides provided on the lance-carrier, parallel to the longitudinal axis thereof, the lugs engaging said slides.

The device may comprise a main shaft mounted in the said trolley, first driving means for rotating the said lance-carrier upon rotation of the said shaft, and second driving means for rotating the said screw upon rotation of the said shaft.

The invention is illustrated by way of example in the accompanying drawings, in which:

Figure 1, subdivided into Figures 1A and 1B, shows an elevational view, partially in section, of a known soot blowing device, this view showing the drive of the blowing lance and the equipment for admitting the blowing fluid in the said lance.

Figure 2, subdivided into Figures 2A and 2B, show an elevational sectional view of a blowing device according to the invention.

Figures 3, 4 and 5, subdivided into Figures 3A and 3B, 4A and 4B, 5A and 5B, show elevational sectional views of blowing devices according to the invention wherein the cooling of the different components comprising said devices is carried out in a different manner from that shown in Figure 2.

The known device shown in Figure 1, comprises a lance 1 provided with nozzles 2 through which escapes the blowing fluid, on being introduced into and withdrawn from the apparatus to be cleaned. The lance 1 can rotate around its longitudinal axis, in order that the blowing fluid shall clear the internal walls of the apparatus of soot deposits accumulated thereon. The lance 1 passes through the walls of the apparatus to be cleaned inside a channel 3 and is driven by a trolley 6 guided on a rail 4 the ends of which are secured by beams 5 to the frame-work of the building housing the apparatus and the blowing devices. Trolley 6 is hauled on rail 4 by means of a chain 7 driven by a reduction gear motor 8. The lance 1 is guided at its end close to the said apparatus, by a bearing carrying a roller 9 and is fastened, at its opposite end with reference to the nozzles 2, to a casing 10 carried by the trolley 6. The casing terminates in a stuffing box 11 which surrounds the blowing fluid feed pipe 12, this pipe being fed through a valve box 13 which admits the blowing fluid to the pipe 12 and from there to the nozzles 2, when a rocker 14, mounted on the trolley 6, tilts a fork 15 which actuates the opening of the valve, the opening of the latter taking place on the lance 1 entering the apparatus to be cleaned, the closing of the valve taking place when the trolley has brought the lance 1 to its rest position (position shown on the drawing). The rotation of the casing 10 and of the lance 1 is effected by the gear wheels 16 and 16^1 housed in the trolley and is controlled by the rotation of a shaft 17, of square cross-section, which is rotatably driven by the reduction gear motor 8.

The known device shown in the Figure 1 has the disadvantage of being very bulky. The devices, according to the invention, shown in the Figures 2, 3, 4 and 5 offer the great advantage that, for a length of lance equal to the length of that of the device described hereinbefore, their total length is substantially reduced by half with reference to the length of the device shown in Figure 1.

The driving and guiding means (4, 7, 8, 9) for the trolley 6, the rotating means (10, 16, 16^1) driven by the shaft 7 of the trolley 6 as well as the blowing fluid pipe 12 and the control means for delivering blowing fluid thereto (13, 14, 15) are similar for embodiments according to the invention (Figs. 2 to 5) and for the known one (Fig. 1) so that not all of the above means have been shown and described for the embodiments of Figs. 2 to 5.

As shown in the Figures 2, 3, 4 and 5, the lance unit generally indicated at 1 comprises two telescopically assembled coaxial components 18 and 19. The component 18 termed hereinafter "the lance-carrier" is fastened, at one of its ends, to the casing 10 carried by the trolley 6 and is guided, at its other end, by a bearing carrying the roller 9. The lance-carrier 18 is of such a length that it may penetrate or be withdrawn from the apparatus to be cleaned by a length substantially equal to one half of the overall length of lance unit 1 when the trolley carries out, on account of the chain 7, a compete stroke. The lance-carrier 18, fastened to the casing 10 by bolts 20, is rotatively driven by the shaft 17 of square cross-section through the gear wheels 16 and 16^1. The actual lance 19 with the nozzles 2, is carried at its end close to said nozzles inside a bearing 21, provided inside the lance-carrier 18 while its other end has a screw tapping 22 cooperating with a screw 23, coaxial with the lance 19 and with the lance-carrier 18, mounted inside the lance 19. The screw 23 is carried by the trolley 6 and driven on its travel along its axis by

the said trolley at the same speed as the lance-carrier 18. The lance 19 is driven in a rotary motion by the lance-carrier 18, through lugs 24 integral with the external surface of the lance cooperating with corresponding slides 25, provided parallel to the axis thereof inside the lance-carrier. When the lance-carrier 18 rotates, it drives the lance 19 in a rotary motion at the same speed as itself and effects at the same time, through the screw 23, the lugs 24 and the slides 25, travelling motion of lance 19 with reference to itself and therefore with reference to the trolley. The length of the screw 23 is considerably shorter than the length of the lance-carrier 18 so as not to be subjected to the effect of deflection to which the lance-carrier 18 may be subjected.

The stroke of the lance 19 is equal to the corresponding stroke of the trolley increased by the relative movement of the lance 19 with reference to the lance-carrier because of the rotation of the lance 19 on the screw 23.

Preferably, so as to ensure the minimum dimension for the device, it is arranged that when the trolley carries out a full stroke, the lance-carrier 18 penetrates in or withdraws from the apparatus to be cleaned by a length substantially equal to one half of the overall length of the lance unit 1 and that the second half of the overall length of the lance unit 1 is provided by the extension of the actual lance 19 relative to the lance-carrier. The screw 23 can be rigidly secured to the trolley or it may rotate inside the said trolley. In the first case, the pitch of the screw 23 should be substantially equal to the translation of the lance-carrier 18 which is covered during a rotation thereof through 360°; in these circumstances the actual lance 19 will have a displacement corresponding to the sum of the movement of the lance-carrier 18 caused by said lance 19 moving together with the lance-carrier 18 plus a movement equal to said pitch, caused by the rotation of the actual lance 19 around the said screw 23. In view of the size generally selected for this working pitch, and the narrow diameter of the screw 23, the pitch of said screw would substantially differ from the pitch of best possible efficiency for such a screw, which would result in heavy wear, great stiffness of operation and possibly seizing. In order to avoid these disadvantages, the screw 23 will, as shown in Figure 2, be rotated, so as to permit, by selecting a favourable pitch with reference to the diameter thereof, a variation of the relative stroke lance-lance-carrier. Indeed, with a pitch as mentioned hereabove, the relative stroke will be zero if the screw 23 rotates in the same direction at the same speed as the lance-carrier 18; the relative stroke lance-lance-carrier will be equal to the pitch of screw 23 if the latter is stationary and equal to twice the pitch of the screw if the latter rotates at the same speed as the lance-carrier 18 with a direction of rotation opposite to that of the lance-carrier.

Screw 23 is hollow and surrounds the blowing fluid feed pipe 12. Said screw comprises an extension 26 mounted inside the casing 10 and is driven by the shaft 17 by means of the gear wheels 27 and 28. In order to invert the direction of rotation of the screw 23 with reference to the direction of rotation of the lance-carrier 18, it is sufficient to intercalate a pinion 29 between the gear wheels 27 and 28 as shown on Figure 2B.

The lance of a soot blowing device has generally to penetrate apparatus at locations where it is exposed to the action of combustion gases at very high temperatures as well as to flame radiation. In order that the metal of the actual lance 19 and the lance-carrier 18 shall retain adequate mechanical characteristics, it is essential to cool the components of the lance. In the devices shown in the Figures 2 and 5, use is made of the blowing fluid itself for the cooling action. The known devices have the disadvantage, that when they are used in very hot areas of the apparatus to be cleaned and in the case of large strokes of the lance, they call for a flow at the nozzles far in excess of that needed for the cleaning alone, this supplementary flow being solely caused by the need to cool the lance. The blowing devices according to the invention offer the advantage of using a lance 19 of fairly narrow diameter. The diameter of said lance may indeed be narrow, considering that the actual lance 19 is of a length substantially equal to one half of the length of a normal lance. The narrow diameter of the lance 19 entails a reduction of the rate of strain of the tube, comprising said lance, where it is fitted inside the lance-carrier 18 with the result that the flow needed for cleaning the apparatus is substantially adequate to cool the lance 19, even in the case of the most heavy thermal stresses. The lance-carrier 18 is of a fairly large diameter considering the mechanical stresses arising from its own weight and from that of the lance 19. In order that it shall retain permissible mechanical characteristics, the lance-carrier has to be efficiently cooled. This cooling will of course be conditioned by the temperatures present in the apparatus to be cleaned at the location where the blowing devices operate. For efficient cooling it is necessary to cool the lance-carrier 18 as well as bearing 21 at the end thereof and which carries the lance 19 while taking care to maintain at a permissible temperature the slides 25 as well as the

threads of the screw tapping 22 and of the screw 23. Depending on the conditions of cost, on the permissible loss of pressure head of cooling fluid within the device and on the temperature to which the tubes of the lance 19 and of the lance-carrier 18 are exposed, there are two solutions of the cooling problem. The first of these solutions makes use of a lance-carrier comprising a single tube, while the second solution provides a lance-carrier 18 comprising two concentric tubes. The first solution is shown in Figure 2. The blowing fluid leaving the feed pipe 12 passes without restriction in the lance 19, according to arrow F; the cross-section of the nozzles 2 conditioning the adequate cleaning flow. The cooling fluid bled from the blowing fluid follows the path shown by the arrows *f*, said cooling fluid flowing between the fluid feed pipe 12 and the inner wall of screw 23 to pass through ports 32, provided in the screw 23, in order to flow between the lance 19 and the lance-carrier 18, the packing ring 31 provided between the screw 23 and the casing 10 preventing any leak of fluid towards the trolley 6. The cooling fluid will be of satisfactory efficiency as it flows inside an annular space of small cross-section. The flow of the cooling fluid may be controlled through the cross-section of flow of the ports 32 provided in the screw 23, but will also be conditioned by the annular space present between the lance 19 and the bearing 21. This annular space bears an immediate relationship to the wear of said bearing. It is therefore necessary to reduce such wear and to provide forcible cooling of the bearing with that end in view. In order to achieve a satisfactory cooling of bearing 21, this is of taper shape and is mounted on the lance-carrier 18 by means of fins 38 disposed in a radial direction, the cooling fluid, flowing between the outer wall of the bearing 21 and the fins 38, passes through cross-sections of increasing size so as to expand more or less adiabatically in order to achieve a satisfactory cooling of the end of lance-carrier 18 and the bearing 21.

The second solution put forward for cooling the lance-carrier 18 may be carried out in several variants, two of which are shown in Figures 3 and 4. The lance-carrier 18 comprises two co-axial tubes 33 and 33^1. Said tubes 33 and 33^1 have their end close to the trolley 6 integral with a common flange 34 (Figure 3) or with a flange in two components (Figure 4) fastened to the flange 26^1 of the casing 10. The flanges 34 and 26^1 provide between one another an annular space 35 made leakproof by the packing rings 31 and 26. Ports 32 and 37 provided respectively in the screw 23 and in the flange 34 allow the cooling fluid to pass, as shown by the arrows *f*, from the interior of the screw 23 into the annular space 35 and, from there, into the annular space provided between the two tubes 33 and 33^1 which make up the lance-carrier 18. As shown in Figure 3, the bearing 21 of the lance 19, drawn out in full, is fastened to the tube 33 of the lance-carrier 18, said tube 33 being supported by tube 33^1 through fins 38 secured either to the tube 33, or to the tube 33^1, this assembly allowing both tubes to expand freely one with reference to the other. In the form of embodiment shown in Figure 3, it will be noted that the cooling flow is quite independent from the wear of bearing 21. In order to prevent wear of said bearing to the fullest possible extent, its cooling may eventually be assisted by the provision of one or a plurality of ports 39 which cause a leak of the cooling fluid along the arrows f^1. The distance d may control the flow of cooling fluid. As the distance d varies in ratio of the temperature of the tube 33^1, when the latter expands the flow of cooling fluid will be the greater, the more said distance d increases, i.e. the greater, the more the temperature of the tube 33^1 rises.

The lance-carrier 18 shown in Figure 4 also comprises two co-axial tubes 33 and 33^1 which are assembled by the flange 34 to the flange 26^1 of the casing 10. The bearing 21 of the lance 19 is mounted inside the tube 33 and the spacing between the tubes 33 and 33^1, at the location of bearing 21, is maintained by members 40 permitting differential expansions of the tubes, said members 40 afforded a maximum restriction of the passage of the cooling liquid to the outside to the extent consistent with an adequate cooling of bearing 21. The blowing fluid feed pipe 12 delivers the blowing fluid within the hollow screw 23 sealed off at its end 41. It is therefore substantially the whole of the flow of fluid meant for cleaning the apparatus which will flow, along the arrows F, to cool the tubes 33 and 33^1, the bearing 21, the screw 23 and lastly the tube comprising the lance 19. This embodiment makes it possible to achieve a forcible cooling of lance-carrier 18, but entails a considerable loss of head of the cleaning fluid. In order to reduce this loss of head, the wall 42 sealing the screw 23 may be provided with an opening 39, the cross-section of said opening being computed so that the flow of fluid passing through the ports 43 of the screw shall be adequate to assure the cooling of the tubes comprising the lance-carrier 18.

It should be noted that the embodiments described shown in the Figures 2, 3 and 4 only differ in the design of the lance-carrier 18. The lance, the screw and the casing

are identical in these three cases. This feature is of interest with reference to the global cost of a soot blowing installation. The devices located in the hottest areas will be the only ones to be provided with a lance-carrier 18 with two tubes 33 and 33^1. The other devices, located in less hot areas, will be provided with a single tube lance-carrier. The temperature of the gases to which these latter devices are exposed being lower, the wear of bearing 21 will be low and to the extent that this wear shall affect the cooling flow, it will affect a flow which will be low for the same reason. This wear of the bearing 21 will therefore not be very considerable.

As mentioned hereinbefore, it is of interest to provide in the devices according to the invention a lance 19 of narrow diameter in order that the flow of cleaning fluid shall be sufficient for the cooling thereof. This entails evidently a fairly narrow diameter for the feed tube 12. As the latter, according to the devices described hereinbefore, has to feed both the cleaning flow as well as the cooling flow of the lance-carrier 18, it may happen that, in the case of the devices located at the hottest locations of the apparatus to be cleaned, the loss of head in the fluid feed pipes becomes prohibitive. For the few devices of a cleaning installation which would be in that case, it would not be economical to design a special blower with larger feed tube diameters and consequently greater diameters of the screw 23, lance 19 and lance-carrier 18. Then, means are provided for retaining the normal dimensions of said components which are adequate for the majority of devices and to supply the devices operating in the hottest locations with cooling fluid by means of a feed separate from the feed pipe 12.

As shown in Figure 5, the cooling fluid is simultaneously fed through a pipe 41 and from the blowing feed pipe 12, into an annular chamber 42, the latter being connected, through ports 50, with the annular space provided between the two tubes 33 and 33^1, the cooling fluid flowing according to the arrows f, between the two tubes, so as to cool the lance-carrier 18 as well as the bearing 21 of the lance 19. A rigid connection 43 between the chamber 42 and the trolley 6 prevents said chamber from being rotated by the lance-carrier 18, packing rings 44 preventing any leakage of the cooling fluid between the chamber and the tube 33^1 of the lance-carrier. The pipe 41 is supplied with fluid by a flexible pipeline connected to a source of cleaning fluid downstream of a blowing fluid inlet valve, similar to the valve 13 of the embodiment of Figure 2, either directly to the valve or, as shown in Figure 5, to the start of the blowing fluid feed pipe 12. The flexible pipeline comprises a hose 45 connected to a rigid pipe 46 in communication with pipe 12. The pipeline could also, for example, be carried out using rigid co-axial tubes fitting one into the other and able to slide along their axis one with reference to the other.

WHAT I CLAIM IS:—

1. A device for blowing out the soot, to clean the inner faces of apparatus such as heat exchangers and boilers, comprising a mobile lance unit to be used to penetrate the said apparatus for the cleaning operations, said lance unit being provided with at least one blowing nozzle and being mounted on a rail-guided trolley for movement therewith, characterized in that the said mobile lance unit comprises two telescopically assembled components, the inner one, named hereinafter the "lance", carrying said nozzle, means for rotating the external one, named hereinafter the "lance-carrier", driving means between the lance-carrier and the lance to rotate the lance as a result of the rotation of the lance-carrier and a screw inside the lance in engagement with a tapping on the inside wall of the lance to move the lance longitudinally relative to said lance-carrier and said trolley as a result of the rotation of the lance carrier and of the lance.

2. A device as claimed in claim 1, wherein said driving means comprise lugs provided on the lance and slides provided on the lance-carrier parallel to the longitudinal axis thereof, the lugs engaging said slides.

3. A device as claimed in claim 1 or 2, wherein the said screw is hollow, so as to admit the blowing fluid feed pipe.

4. A device as claimed in any preceding claim, wherein means are provided for rotating the said screw.

5. A device as claimed in claim 4, comprising a main shaft mounted in the said trolley, first driving means for rotating the said lance-carrier upon rotation of the said shaft, and second driving means for rotating the said screw upon rotation of the said shaft.

6. A device as claimed in claim 5, in which the said screw is provided with a rotary movement, around the axis thereof, taking place in a direction contrary to the rotary movement imparted to the lance-carrier, the reversal of the direction of rotation of the said screw being achieved by providing a pinion between a driving gear wheel driven by the said shaft and a driving gear wheel integral with the screw.

7. A device as claimed in any preceding claim, wherein the lance is guided, on the one hand, by the said screw and, on the other hand, by a bearing mounted, close to

its end remote from the trolley, inside the lance-carrier, the portion of the said screw, housed inside the lance sections, being of a length considerably shorter than the length of the lance-carrier, so as not to be subject to the effects of the deflection to which said lance-carrier may be subjected.

8. A device as claimed in any preceding claim, wherein the cooling of the lance is carried out by the blowing fluid flowing in the said lance, the cooling of the screw and of the lance-carrier being carried out by the flow of blowing fluid between the feed pipe of said fluid and the inner wall of the screw, the latter being provided with one or more ports through which the said fluid may pass to flow between the lance and the lance-carrier.

9. A device as claimed in claim 7 or 8, wherein the said bearing is mounted on the lance-carrier by means of fins, said bearing being so designed that the cooling fluid escaping between the lance and the lance-carrier at the end thereof remote from the trolley and flowing between the outer wall of the bearing and the said fins passes through cross-sections of increasing size so as to expand more or less adiabatically in order to achieve an excellent cooling.

10. A device as claimed in any one of claims 3 to 9, wherein the lance-carrier comprises two concentric tubes made integral one with the other at their end close to the trolley, where holes are provided for entry of cooling fluid, the spacing between the two tubes being maintained, at their other end by radially mounted fins.

11. A device as claimed in claim 10, wherein the cooling fluid, bled from the blowing fluid, passes through the said port provided in the screw to flow afterwards between the two tubes providing the lance-carrier, the tube of smaller diameter having one or more ports located upstream of the guide bearing of the lance and through which the fluid may pass in order to cool said bearing, the screw and the lance being cooled directly by the flowing fluid.

12. A device as claimed in claim 10, wherein the said hollow screw is sealed off at the end thereof closest to the said lance nozzle, the whole of the blowing fluid, flowing from the feed pipe located inside the screw, passing between the lance-carrier two concentric tubes, the whole of the flowing fluid with the exception of the minimum loss of fluid needed for cooling the said bearing as well as of the components maintaining the spacing between the said two tubes and substantially sealing off the free space inbetween the latter, passing through the said port located upstream of the glide bearing of the lance and through at least one port provided close to the end of the lance remote from said nozzle, inside the lance in order to be ejected, through the latter, in the apparatus to be cleaned.

13. A device as claimed in claim 12, wherein to prevent too heavy losses of pressure head of blowing fluid, part of the blowing fluid passes immediately from the inside of the said screw to the inside of the lance, through an opening provided in the wall sealing off the screw.

14. A device as claimed in claim 10, wherein the cooling fluid is fed through a hose to a chamber surrounding the lance-carrier, said chamber being connected to the said trolley, for example by means of a rigid member, so as not to be drawn into a rotary motion, said chamber communicating with the space provided between the two tubes making up the lance-carrier, through an opening provided in the tube of larger diameter, the screw and the lance being directly cooled by the internal flow of the blowing fluid.

15. A device for blowing out the soot to clean the inner faces of apparatus such as heat exchangers and boilers, constructed and arranged substantially as herein described with reference to and as shown in Figures 2, 3, 4 or 5 of the accompanying drawings.

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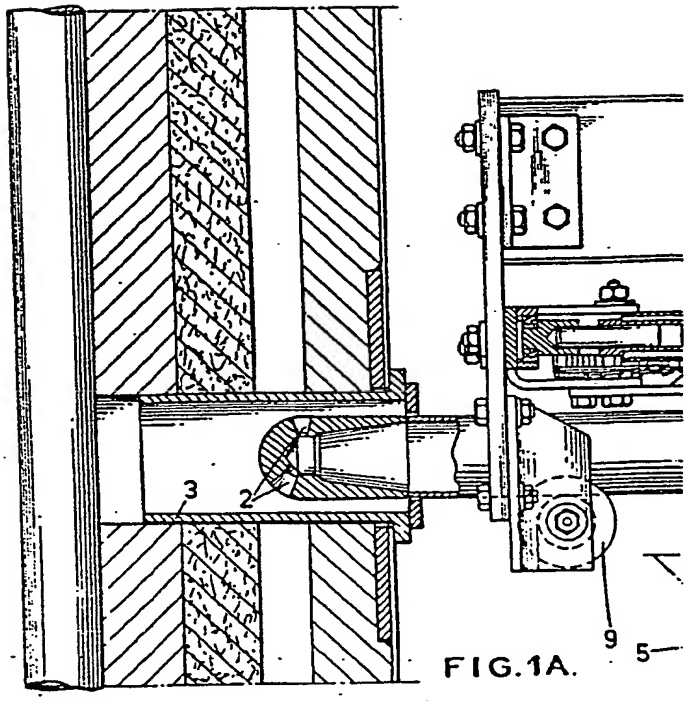
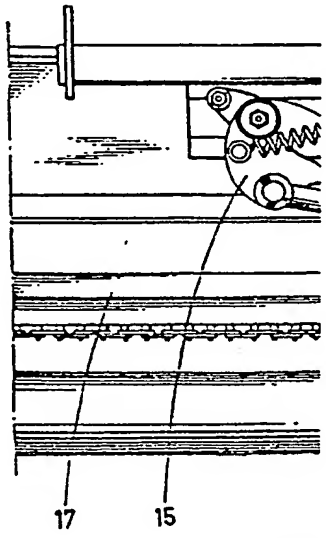


FIG.1A.



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1160439 COMPLETE SPECIFICATION

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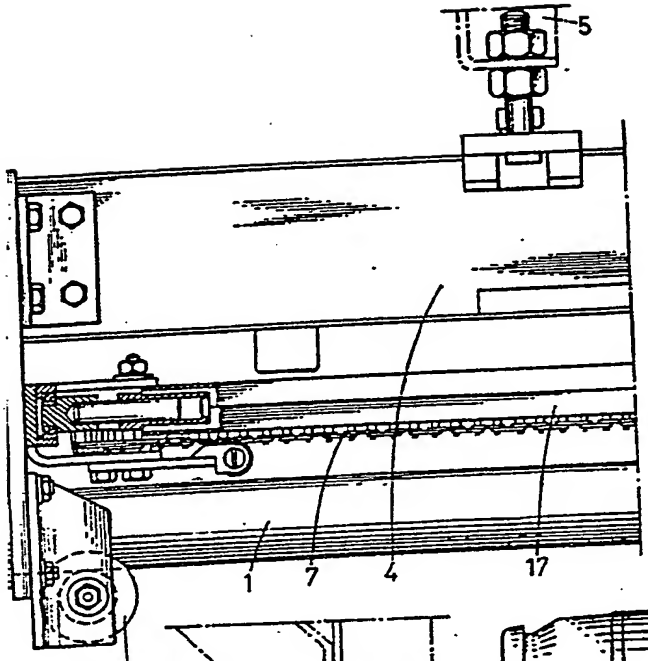

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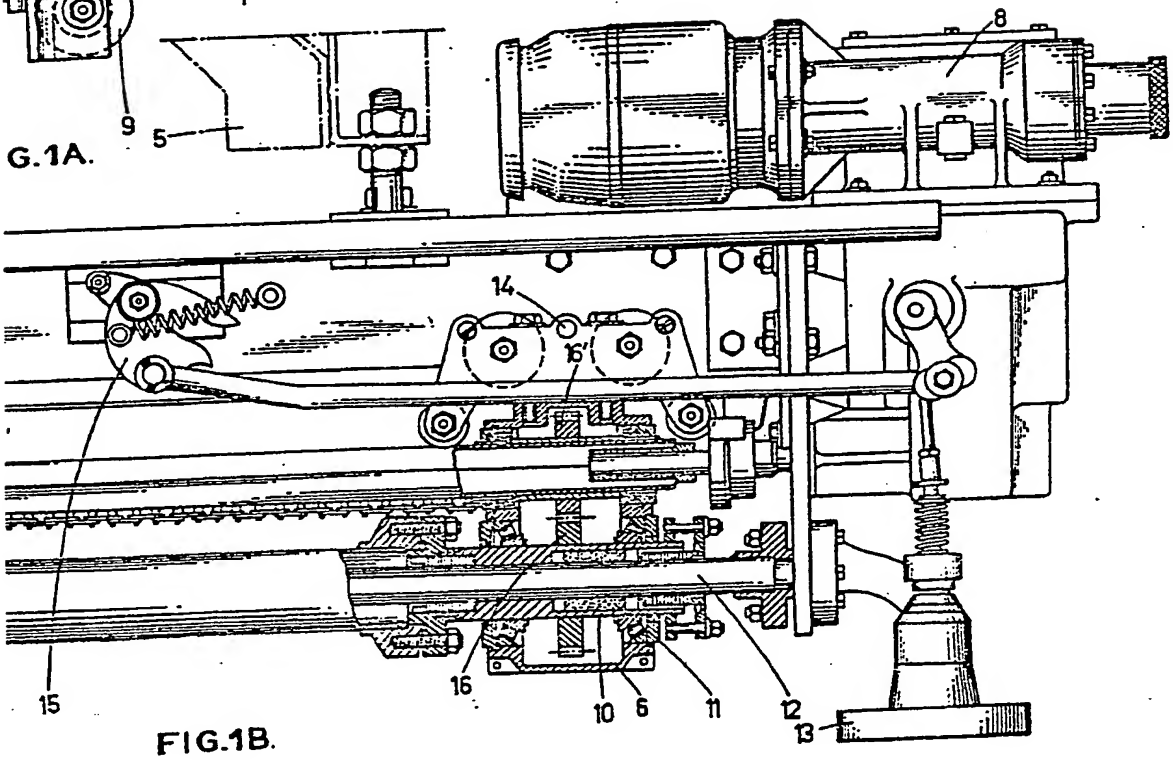

FIG.1B.

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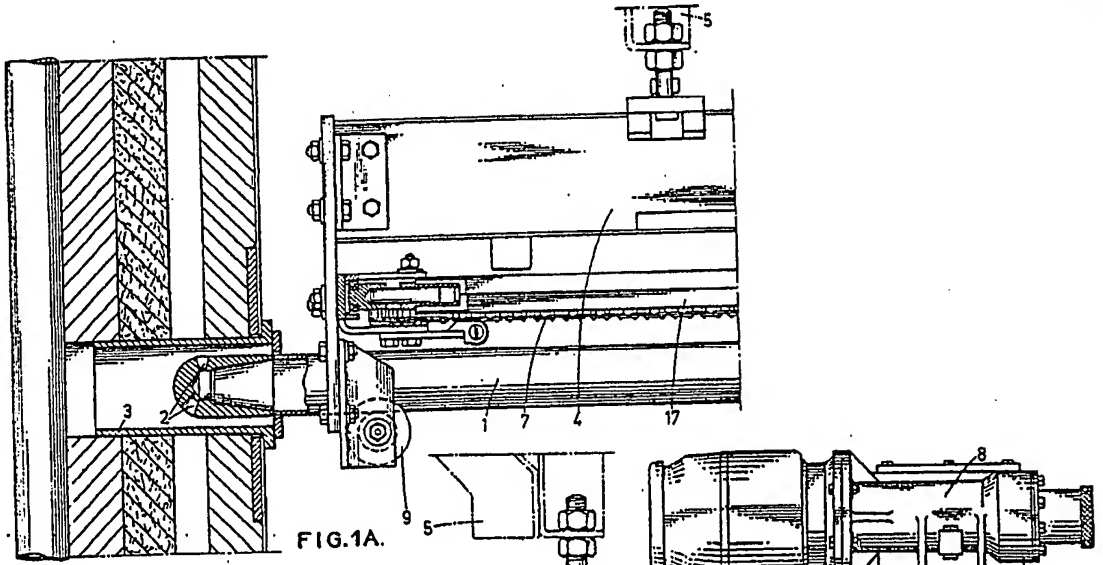


FIG.1A.

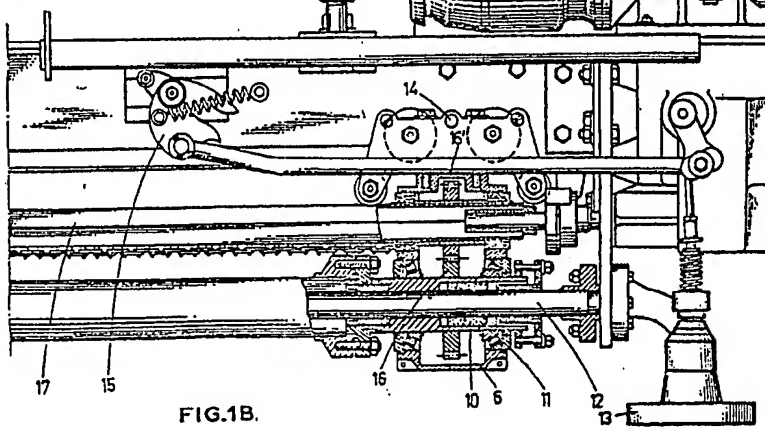
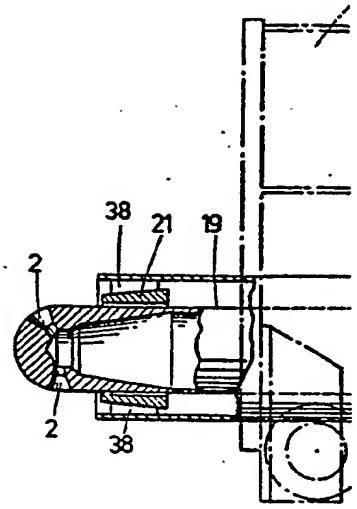


FIG.1B.



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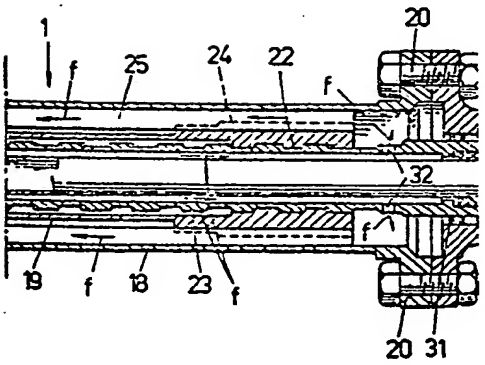

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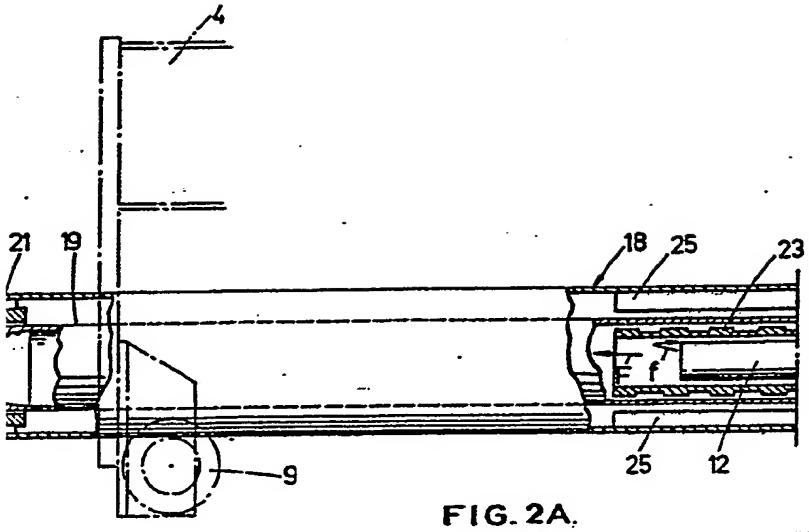

FIG. 2A.

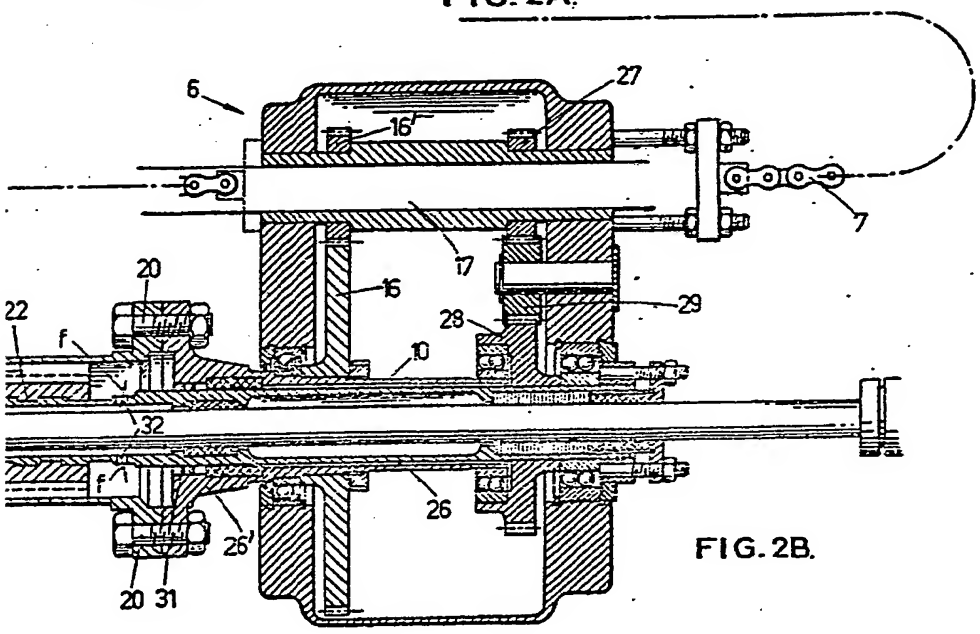

FIG. 2B.

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Sheet 2

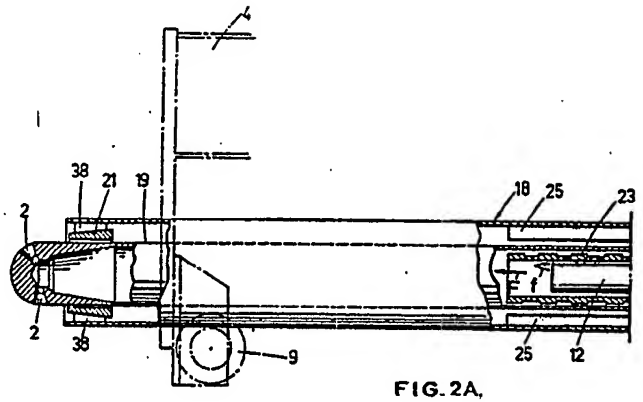


FIG. 2A.

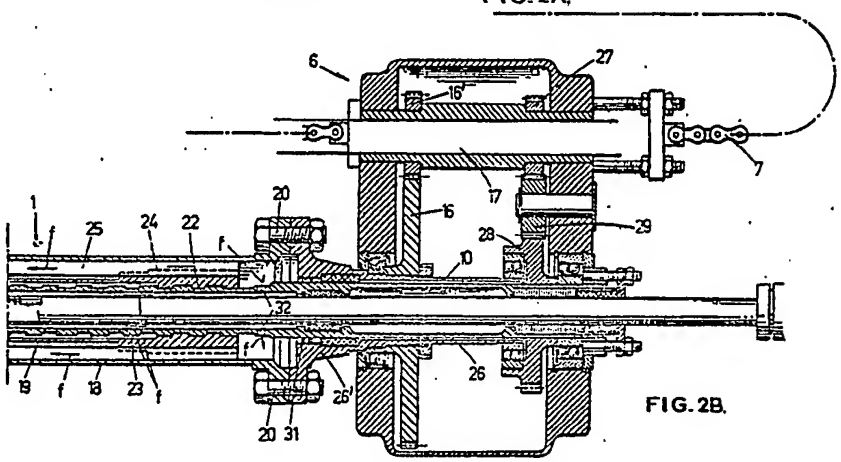
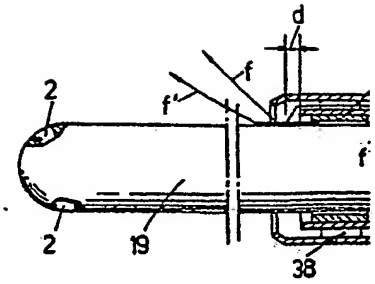
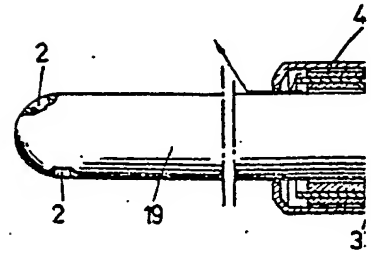


FIG. 2B.





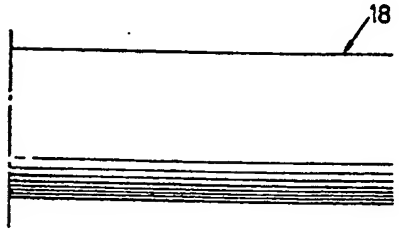


FIG.3B

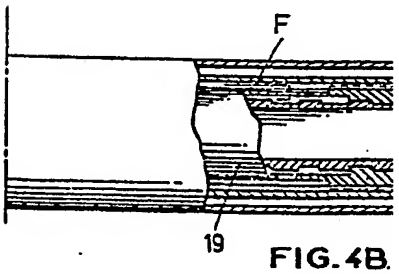


FIG.4B.

1160439 COMPLETE SPECIFICATION
4 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 3

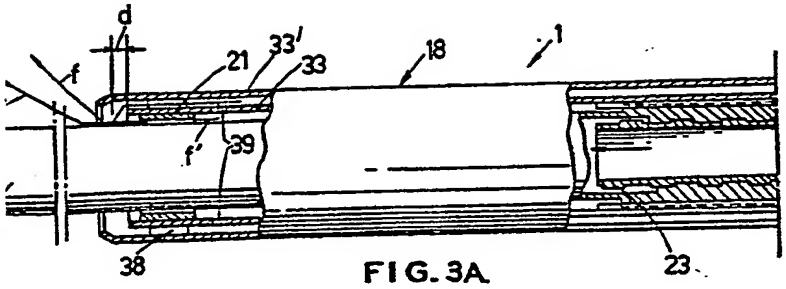


FIG. 3A.

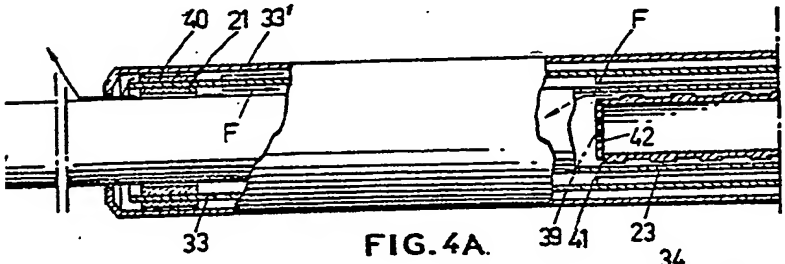


FIG. 4A.

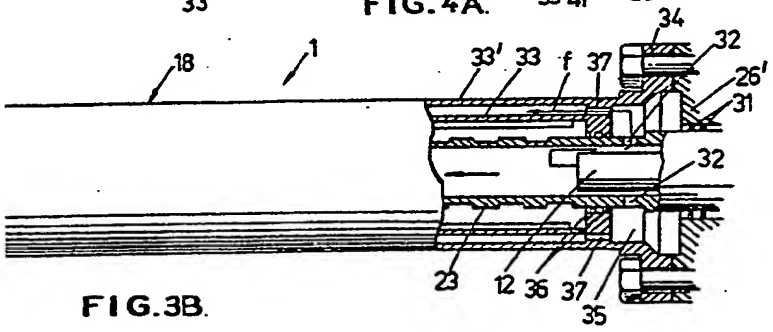


FIG. 3B.

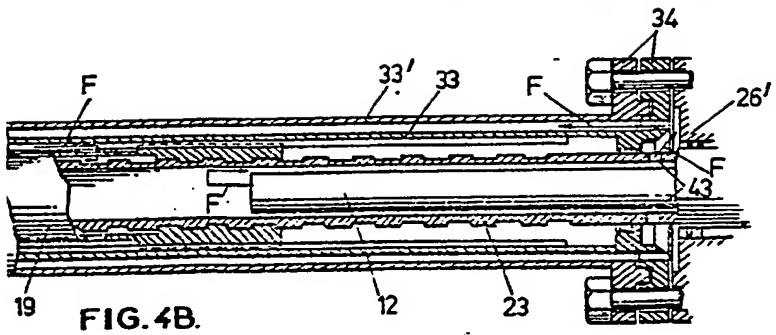


FIG. 4B.

1160439 COMPLETE SPECIFICATION
4 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 3

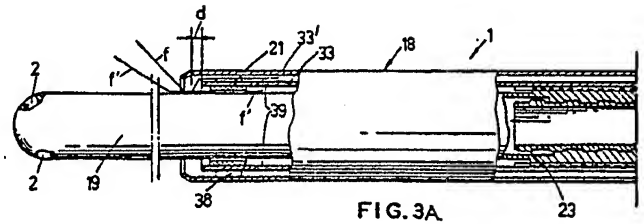


FIG. 3A.

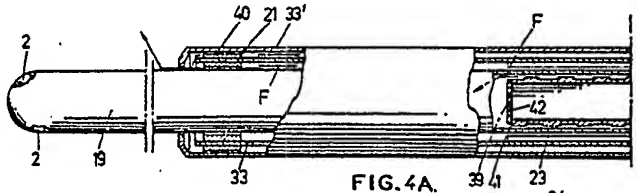


FIG. 4A.

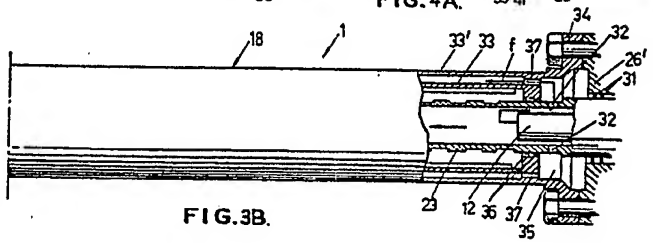


FIG. 3B.

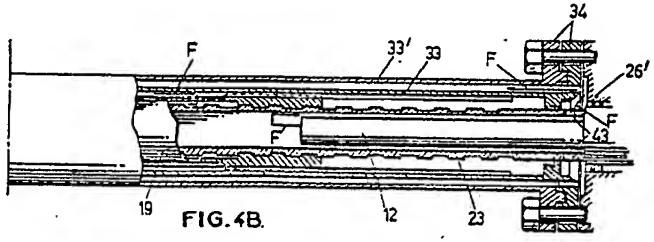


FIG. 4B.

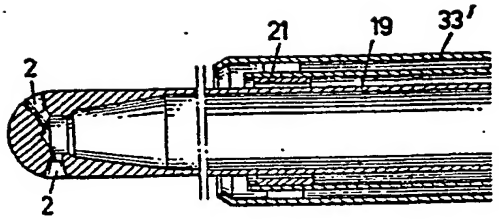
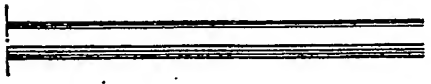
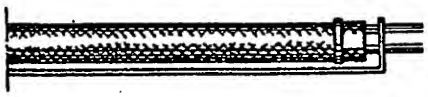


FIG. 5A.





1160439 COMPLETE SPECIFICATION
4 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 4

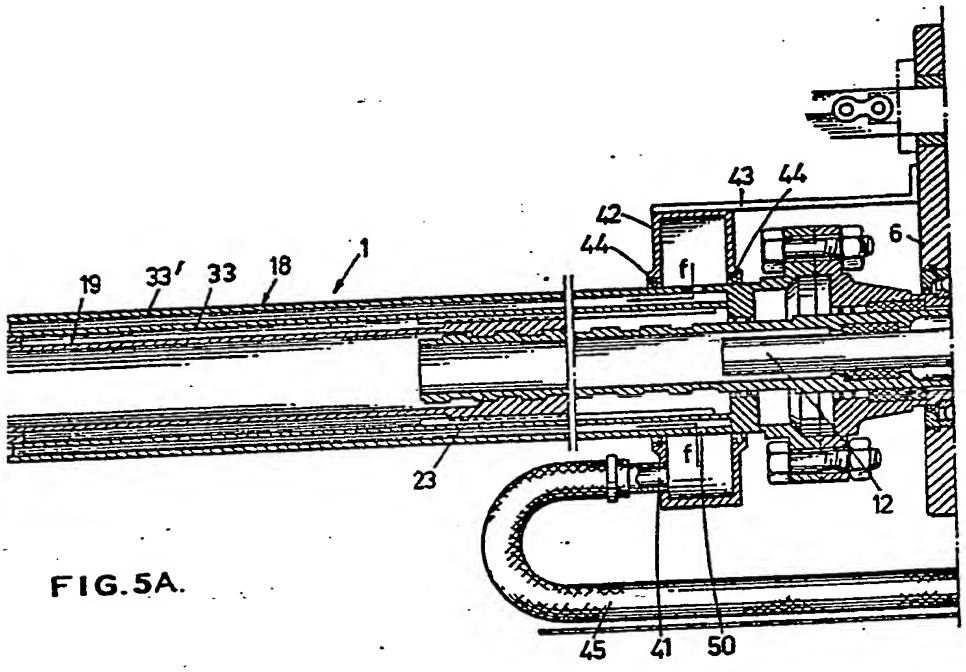


FIG.5A.

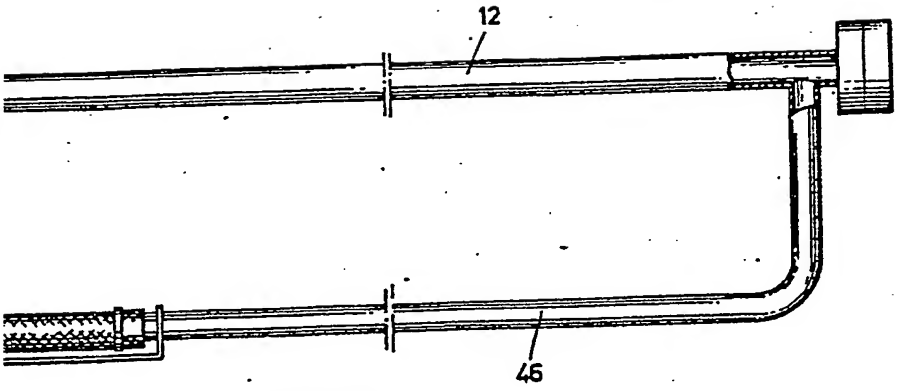


FIG.5B.

1160439 COMPLETE SPECIFICATION
4 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 4

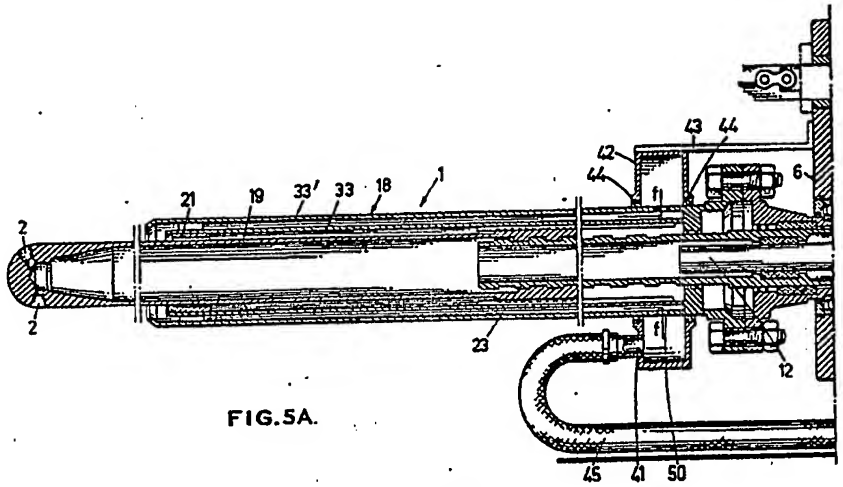


FIG.5A.

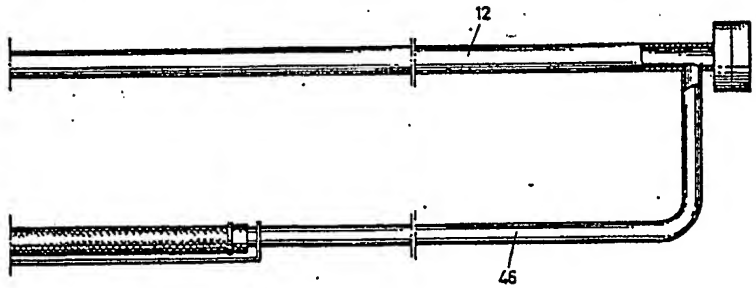


FIG.5B.